Direct effect of pollen grain on the physical and chemical characteristics of the fruits of guava (*Psidium guajava*)

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Abstract

The present study investigated the influence of pollen parents, “Arka Kiran” and “Baruipur” on the morphological and biochemical properties of two guava (*Psidium guajava* L.) cultivars: “Shweta” and “Allahabad Safeda”. Controlled cross-pollination was conducted using the “Arka Kiran” and “Baruipur” pollen donors to obtain crossed fruits. Crossed fruits were compared with selfed fruits of both seed parents “Shweta” and “Arka Kiran” to examine resultant variations in fruit characteristics. The results showed significant differences in fruit weight, diameter, seed number, and biochemical properties such as total soluble solids and ascorbic acid content. Pollen donors couldn’t significantly increase the fruit weight on seed parents except “Shweta” x “Arka Kiran”. However, pollen donors were found to decrease the number of seeds in “Shweta” and “Allahabad Safeda”. “Arka Kiran” and “Baruipur Local” resulted in enhanced Total Soluble Solid (T.S.S) content of fruits in “Allahabad Safeda”. “Allahabad Safeda”, when crossed with “Arka Kiran”, produced fruits with increased Ascorbic Acid content. Statistical analysis confirmed that cross-pollination in guava impacts fruit quality traits, indicating a potential for enhancing crop yield and quality through strategic breeding practices. The research bridges a gap in the literature on xenia and metaxenia effects in guava, providing insights for horticultural improvements and value-added product development.

INTRODUCTION

Guava (*Psidium guajava* L.) is an important fruit crop in India for its highly nutritious and delicious fruits with strong, sweet aroma. The fruit belongs to the family Myrtaceae (Grattapaglia et al., 2012) and has a diploid chromosome number of 2n = 22 (Coser et al., 2012). The crop was introduced to India by the Portuguese in the early 17th century (Menzel, 1985). India ranks first in guava production with 5.6 million metric tons from 359 thousand hectares of land (Keelery, 2023). Guava fruits are rich sources of Vitamin C (228 mg/100g), Vitamin A (624 IU/100g), minerals (Potassium, Magnesium, Calcium, Iron) and dietary fibres (USDA, 2018).

Guava is a cross-pollinated crop although flowers are bisexual and cross-compatible. The extent of cross-pollination in guava is around 35–40% (Sarkar et al., 2022). The effect of different strains of pollens on the physical and biochemical properties of fruit crops has been studied for a long time. The impact of pollen-parents on female plants can be discussed under two broad terms: hybridisation and xenia/metaxenia. In hybridisation, the effect of pollen-parent is measured in the next generation i.e. in the F1 generation. In contrast, the immediate impact of pollen-parent on female plants during pollination i.e. in the F0 generation is either called xenia or metaxenia depending on the part of the ovary under the influence.

In biology, the impact of pollens on embryos and endosperm is termed “Xenia.” In contrast, "Metaxenia" occurs when the genotype of the pollen influences components other than the embryo and endosperm, like tissues that are wholly composed of mother plant material, seed parts like the nucellus and testa, and even carpel and ancillary tissues (Yang et al., 2020).

Xenia and Metaxenia have been studied in several horticultural crops as observed in Table 1.

The immediate effect of pollen parents was studied in Sweet Cherry (Rasouli & Arzani, 2011), Date Palm (Refdan Al-Hajhoj et al., 2020), Dragon fruit (Mizrahi et al., 2004), Pomegranate (Gharaghani et al., 2017), Almonds (Sanchez-Perez et al., 2012, Alizadeh- Salte et al.,2018), Hazelnut (Balik & Beyhan, 2019), Macademia (Herbert et al.,2019), and Chestnut (Liang et al., 2016). However, very few studies (Usman et al., 2013) have investigated guava in this context. To bridge this gap in literature this paper studies the impact of pollens on physio-chemical properties of inter-varietal crosses of guava.

MATERIALS AND METHODS

1. Plant Selection:

Intending to study the influence of pollen parents on the morphological and biochemical properties of guava cultivars viz. ‘Shweta’ and ‘Allahabad Safeda’, two pollen donors viz. ‘Arka Kiran’ and ‘Baruipur Local’ were selected.

Shweta (Seed Parent 1)

CISH ‘Shweta’ is one of the high-yielding guava varieties with a high Vitamin C content. The plants are tolerant to biotic and abiotic stresses and have good keeping quality.

Allahabad Safeda (Seed Parent 2): This is the most famous variety in Uttar Pradesh for table purposes. The fruits are medium (180g), round in shape, and have few seeds. The pulp is white and has good keeping quality.

Arka Kiran (Pollen Parent 1)

It is a hybrid between Kamsari and Purple Local. The pulp is firm and deep pink, and the cultivar was selected for its pink pulp colour.

Baruipur Local (Pollen Parent 2)

Fruits are round with glossy yellowish skin. The flesh is white and has good taste and flavour.

2. Treatment combination:

Each female parent or seed parent was crossed with each male parent or pollen parent to obtain mature fruits. For the experiment, three plants of 'Shweta' and 'Allahabad Safeda' were selected and used as replications. Similarly, three healthy plants of 'ArkaKiran' and 'Baruipur Local' were marked and used as replications. Female flowers for the experiment were selected from female parents (syn. seed parent) and male flowers were selected from male parents (syn. pollen parents). Several hundred crosses were made between male and female flowers during Hasta-Bahar (October) and Ambe-Bahar (February). Mrig-Bahar (June) season was deliberately avoided as the monsoon in West Bengal stays until the end of September or October starting from June. Reportedly during the Mrig-Bahar season, flowers and fruits get damaged easily. Some flowers of the female parents were selected for self-pollination i.e. they were pollinated with pollens of their own. The fruits obtained from self-pollinated female flowers were considered as controls for the experiment.

Table 2
Treatment combinations of the experiment

Group 1	Group 2
"Allahabad Safeda" × "ArkaKiran" (T1)	"Shweta"× "Arka Kiran" (T3)
"Allahabad Safeda" × "Baruipur Local" (T2)	"Shweta"× "Baruipur Local" (T4)
Control: Self-pollinated fruits of "Shweta" (T5)	Control: Self-pollinated fruits of "Allahabad Safeda" (T6)

It is worth mentioning that no reciprocal crosses were made during the experiment.

3. Pollination:

Crossing between male and female flowers was carried out at the Horticultural Research Station, Mondouri, Nadia, West Bengal, from 2014–2016. A detailed step-by-step procedure for artificial pollination is described below:

1. Floral buds at the calyx splitting stage (BBCH E3:57: Flower petals elongating, sepals slightly open, petals just visible.) were selected. Emasculation i.e. process of removing the anthers from a flower bud before they dehisce, was carried out the evening before hand-pollination. Emasculation helps to prevent self-pollination in guava. Sharp, pointed forceps were used to remove the anthers from female flowers. After every use, forceps were dipped in 95% ethyl alcohol and wiped with absorbent cotton to avoid the introduction of unwanted pollen grains.
2. Bagging was done on the same flowers followed by emasculation. Bagging is the process of covering the emasculated flower with a bag to prevent the flower from getting pollinated by undesired pollens. Cotton muslin cloth bags were used instead of plastic bags for bagging. These bags were biodegradable, recyclable and most importantly breathable.
3. Unopened flowers (BBCH stage E3:57) from pollen parents were also selected and bagged simultaneously on the same evening. This was done to avoid any chance of mixed pollen in the hybridization programme.
4. Some flowers of "Shweta" and "Allahabad Safeda" were left for self-pollination. Bagging of these flowers was also done to protect the stigmatic end from coming in contact with any 'foreign' pollen. These flowers were pollinated the next morning by opening the bags quickly and gently rubbing the anthers against the stigma. Flowers were then bagged and tagged immediately.
5. For artificial pollination, at first, pollens from pre-selected and bagged flowers were collected the next morning. Anthers were picked just after dehiscence in a petri dish and gently pressed with the tip of the forceps. After the pollens were released,

previously emasculated and bagged female flowers were opened for a few seconds. The stigmatic surface of the female flowers was gently smeared (within 8 a.m.) with the desired pollen with the help of a brush. Immediately after, the flowers were bagged and tagged accordingly. Sterilized tools were used each time for pollen collection and pollination.

At maturity, ten well-grown crossed fruits of each treatment were harvested 120 days after fruit set from replicated trees. Observations on the morphological and quality characteristics of those crossed fruits were recorded. Simultaneously, hand-pollinated selfed fruits were also developed in female parents. Ten such fruits (selfed) were harvested 120 days after fruit set for observations.

4. Physical characteristics:

Fruit weight, fruit length, fruit diameter, length-diameter ratio, number of seeds per fruit, seed weight per fruit, size and texture of seeds were studied in randomly selected fruits from each plant of different genotypes and their crosses. Average of 20 fruits was calculated and data were subjected to statistical analysis. Moreover, fruit colour, fruit shape, relief of surface and presence of ridges were also recorded for each treatment.

5. Chemical characteristics:

All the fruits of each replication were peeled off with a stainless steel knife. The juice of the guava fruits was extracted from each sample and homogenized to study the biochemical parameters i.e., Total Soluble Solids (TSS) and ascorbic acid

a) Total Soluble Solids (° Brix):Total soluble solids (TSS) content of fruits were estimated with the help of an ERMA hand refractometer (0 to 32°Brix) and the values were corrected at 20°C. A few drops of fruit juice extracted from each sample was placed on prism in the specimen chamber of the refractometer to record the reading (Mazumder and Majumder, 2003).
b) Ascorbic Acid (mg/100g): Ascorbic acid content of the head was determined by the procedure given by Ranganna, (2007) and was expressed in mg/100g.

6. Statistical analysis

The observations recorded were subjected to statistical analysis by adopting the Randomized Block Design (RBD) method suggested by Panse and Sukhatme (2000). The treatment variations were tested for significance by adopting F test (Cochran and Cox, 1958). For determination of critical difference at 5 percent level of significance Fisher and Yates (1963) table was consulted.

RESULTS

1. Fruit Weight:

The weight of the crossed fruits varied significantly from the selfed fruits (hand pollinated) of var. ‘Shweta’ and “Allahabad Safeda’.’ The fruit weight of selfed fruits of var. ‘Shweta’ (T5) was 148.35 g., at par with the fruits of “Shweta” × “ArkaKiran” (T3), i.e. 148.42g.On the contrary, fruits of “Shweta”× “Baruipur Local’ Local’ (T4) showed a significant reduction (131.48 g.) in fruit weight than the selfed fruits of “Shweta’.’Furthermore, the average weights of selfed fruits of A.S (83.03 g) were higher than the fruits of both cross combinations. The fruit weight of the crossed fruits of “Allahabad Safeda” × “Arka Kiran” and “Allahabad Safeda” × “Baruipur Local’ Local’ were 62.21 g. and 65.29 g. respectively. However, the average weight of “Shweta” × “Baruipur Local’ Local’ (T4) fruits was higher than selfed fruits of “‘Shweta”.

2. Fruit Length:

The selfed fruits of A.S had an average length of 52.75 mm, higher than the crossed fruits (45.96mm for “Allahabad Safeda”× “Arka Kiran” and 46.87 mm for “Allahabad Safeda’ × ‘Baruipur Local’ Local’). The results show that neither pollen donor genotype could raise the fruit length of A.S. Similarly, it was observed that the average fruit length of selfed fruits of “‘Shweta” is 57.81mm, which was more than fruits from both the cross combinations, i.e. 56.10mm (var. ‘Shweta’× “Arka Kiran”) and 54.81 mm. (“Shweta” × “Baruipur Local’ Local’) showing statistical significance.

3. Fruit Diameter:

Under the climatic conditions of HRS, Mondouri, B.C.K.V., the open-pollinated fruits of var. 'Shweta' was always bigger than the fruits of "Allahabad Safeda'.' The fruit diameter of "Allahabad Safeda" × "Arka Kiran" (T1) is 47.67 mm. and that of "Allahabad Safeda" × "Baruipur Local' Local' (T2) is 50.04mm, which decreased significantly from hand-pollinated selfed fruits of "Allahabad Safeda" (T6) (51.63mm).

On the contrary, the diameter of crossed fruits of "Shweta"× "Arka Kiran" (T3) had been increasing (66.29mm) from hand-pollinated selfed fruits of var. 'Shweta' (65.93mm). Crossed fruits of var. "Shweta" with "Baruipur Local' Local' as a pollen parent had an average diameter of 60.55mm, significantly less than the selfed fruits of "Shweta"(T5), i.e.65.9,3 mm.

4. Length/diameter:

Fruit shape is evaluated from the length/diameter ratio. The selfed fruits of 'Allahabad Safeda' had a ratio of 5.799, while in the case of "Allahabad Safeda" × "Arka Kiran" and 'Allahabad Safeda" × "Baruipur Local' Local' they were 5.629 and 5.554 respectively. Selfed fruit of 'Shweta' was found to have a ratio of 5.371. When var. 'Shweta' was crossed with var. 'Arka Kiran' ratio decreased to 5.27, contrarily it increased to 5.471 when 'Baruipur Local' Local was a pollinizer.

5. Number of seeds/Fruit:

The selfed fruits of "Allahabad Safeda" had been found to contain 205.36 seeds on average. The number of seeds decreased significantly when "Allahabad Safeda" flowers were crossed with "Arka Kiran" (198.70 seeds) and "Baruipur Local' Local' (155.90 seeds). However, Seeds became bold when "Arka Kiran" was selected as the pollen parent. 'Shweta' had 230.89 seeds on average, significantly less than the fruits resulting from the crossed combinations. The number of seeds in crossed fruits i.e., "Shweta"× "Arka Kiran" and "Shweta" × "Baruipur Local' Local', were 293.23 and 288.95, respectively.

6. Seed weight/fruit:

The average weight of seeds extracted from crossed fruits of "Allahabad Safeda" × "Arka Kiran" was 1.39 g., which was significantly higher than the seed weight of hand-pollinated selfed fruits of "Allahabad Safeda" i.e. 1.20 g. Selection of "Baruipur Local' Local' as pollen donor parent markedly decreased the total seed weight (1.10 g.).

In case of selfed fruits of "Shweta", total weight of the seeds per fruit was 3.90g on average. The seeds of crossed fruits of "Shweta" × "Baruipur Local' Local' weigh 2.79 g., significantly less than the former. "Arka Kiran", again in this cross combination with "Shweta" significantly enhanced the seed weight per fruit on average to 4.11 g.

7. Colour and Shape of Fruit:

The hand-pollinated selfed fruits of "Allahabad Safeda" were oval and light or whitish green. However, the crossed fruits of "Allahabad Safeda" × "Baruipur Local' Local' were somewhat oval and whitish green. Moreover, the fruits of "Allahabad Safeda" ×"Arka Kiran" were yellowish green and pome-shaped. "Shweta" is known for its big and dark green fruits. Crossed fruits on "Shweta" were green and pome shaped.

8. Relief of Surface and Presence of Ridges:

Surface of "Allahabad Safeda" fruits was smooth and devoid of any ridges while that of var. 'Shweta' was rough or uneven with prominent ridges. The crossed fruits of "Allahabad Safeda" × "ArkaKiran" had longitudinal ridges arising from base ofthe peduncle. The ridges divided the peduncle attachment region in five equal divisionsand the finished in the calyx end. The fruits of "Allahabad Safeda" × "Baruipur Local' Local' hadridges on peduncle end and then disappeared. Fruits of "Shweta"× "ArkaKiran" and"Shweta"× "Baruipur Local' Local' had more or less prominent ridges. The crossed fruits on "Shweta" as always had prominent ridges but they became more prominent when "Shweta" was crossed with "Baruipur Local' Local'.

Table: Morphological characters of fruits in the experiment:

Treatments	Fruit Colour	Fruit Shape	Relief of surface	Presence of ridges
T_1	Yellowish Green	Pome	Smooth	Present
T_2	Whitish green	Slightly oval	Smooth	Present (Less prominent)
T_3	Green	Pome	Rough	Present
T_4	Green	Pome	Rough	Present
T_5	Dark Green	Pome	Rough	Present
T_6	Light Green	Oval	Smooth	Absent

9. Chemical Parameters

Total Soluble Solid:

The Total Soluble Solid content of selfed fruits of “Shweta” was 10.84º. Furthermore, none of the pollen donor genotypes could increase the T.S.S content of the crossed fruits in “Shweta”. In crossed fruits of “Shweta”×“Arka Kiran”, the total soluble solid content was 9.19 ºBrix and in “Shweta”× “Baruipur Local’ Local’, the T.S.S. was 9.35 ºBrix. The T.S.S. of the fruits of “Allahabad Safeda” was 7.77 ºBrix. However, the T.S.S. of the crossed fruits on “Allahabad Safeda” had increased appreciably when crossed with “ArkaKiran” (9.3º Brix) and “Baruipur Local’ Local’ (9.27º Brix).

Ascorbic Acid/ Vitamin C

Freshly harvested selfed"Allahabad Safeda" fruits were found to contain 162.21 mg of vitamin C per 100 g of edible pulp. On the other hand, the estimated vitamin C content of the crossed fruits, “Allahabad Safeda” x “ArkaKiran” was 184.07 mg/100 g, much higher than that of the selfed fruits. Conversely, when “Baruipur Local’ Local’ was used as a pollen donor, the amount of vitamin C dropped significantly to 91.811 mg. Selfed fruits of “Shweta” had a noticeably high vitamin C content of 203.01 mg/100 g of edible fruit pulp. Both cross combinations with var. “Shweta” as the female parent had a significant drop in vitamin C content. “Shweta”× “ArkaKiran” and “Shweta”× “Baruipur Local’ Local’ contained 126.60 mg and 133.90 mg Ascorbic acid respectively.

DISCUSSION

In our experiment, pollen parents did not significantly enhance the average weight of crossed fruits on both seed parents, except for "Shweta"× "Baruipur Local’ Local' (T4). In contrast, previous researchers have observed an increase in fruit weight due to different pollen donors in Guava (Usmanet al.2013), Wax Apple (Tuan et al.,2013), and Litchi (Stern et al.,1993). However, this discrepancy could be a result of species-specific differences or environmental factors influencing the outcome.

The selection of "Arka Kiran" and "Baruipur Local’ Local' as pollen parents was beneficial for reducing the number of seeds per fruit. However, "Arka Kiran" as a pollen donor resulted in bolder seeds, increasing the total seed weight of the crossed fruits. Our results support the idea proposed by Stern et al. (1993) where cross-pollination led to heavier seeds in Litchi. The genetic contribution from the pollen parent can affect the size and number of seeds within the fruit. This is consistent with the concept of xenia, where the pollen's genetic material directly influences seed characteristics. To add more, bold seeds can reduce the marketability and export potential of guava to an alarming extent. Reducing the number of seeds and developing seedless cultivars are key objectives in guava breeding programs and can be achieved through selective breeding, genetic modification and CRISPR. However, identifying pollen donors to develop fruits with less number of soft seeds and using them under controlled cross pollination can be useful to achieve this goal.

"Arka Kiran" and "Baruipur Local’ Local' as pollen donors in “Allahabad Safeda” produced fruits with enhanced T.S.S. of 20.07% and 19.33%, respectively. This pattern of results is consistent with previous literature by Usman et al. (2013), where the guava cultivar 'Round' as a pollen donor increased the T.S.S content of fruits on the cultivar 'Pyriformed.' Similarly, Sharma and Singh (2008)

observed in Papaya that Coorg Honey Dew as a pollinator in Pusa Nanha, Chada Farm Selection, Pusa Dwarf, and Honey Dew papaya produced fruits with 1.60%, 5.23%, 2.70%, and 1.57% more T.S.S, respectively, over their sib or self-pollinated fruits. Furthermore, Sharma and Singh (2008) reported an increase in T.S.S content from 8.50 °Brix to 9.54 °Brix in Tripura Local papaya when flowers were pollinated with pollens from Chada Farm Selection instead of Honey Dew. The Powderblue cultivar of Blueberry was no exception, as the pollen source increased the T.S.S content of the berries (da- da-Silveiraet al., 2011).

"Allahabad Safeda',' when pollinated with pollens of "Arka Kiran',' increased 24.86 mg of ascorbic acid/100 g edible fruit pulp compared to a female parent. Usman et al. (2013) reached a similar conclusion in guava. Davarynejad et al. (1988 and 1990) studied the effect of the pollen parent on fruit quality in 32 different combinations of apple trees in Hungary, concluding that the ascorbic acid content of fruits of 'Duncan Red Delicious' and 'Idared' increased when pollinated by the cultivar 'Gloster.' Taken together, our findings indicate the metaxenial effect of the pollen parents.

From the above discussion it is clear that the genetic makeup of the pollen parent can have impact on various pomological traits like fruit weight, number of seeds per fruit, weight of seeds per fruit through direct and indirect mechanisms. Moreover, genetic compatibility between seed and pollen parent can have an effect on biochemical composition of fruits. The increase in T.S.S. and ascorbic acid content observed in our study when "Allahabad Safeda" was pollinated with "Arka Kiran" suggests that favorable genetic interactions can enhance fruit nutritional quality.

Finally, understanding and leveraging xenia and metaxenia in breeding programs can provide a strategic advantage in developing superior fruit varieties that meet consumer preferences and market demands.

Declarations

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Table 1 and 3 To 6

Table 1: Effect of xenia and metaxenia in some fruit crop

Species	Phenotypic characteristics of xenia and metaxenia	References
Grape	The high berry set percentage, increased weight, length, and width of the berry and number of seeds per berry	Sabir (2015)
Annona sp.	Increased fruit set, quicker fruit maturity, large fruit shape and symmetrical fruits	Jalikop& Kumar(2007)
Olive	Increased fruit weight, fruit size, seed weight, pulp weight, and double-seed fruit Production.	Gharaghani et al.,(2017)
Kiwifruit	Average fruit weight, fruit biochemical characteristics and seed weight, number and protein content	Stasiak et al., (2019)
Guava	Fruit size, shape, weight and quality	Usman et al., (2013)
Lemon cultivar “Kagzi Kalan”	“Bhadri”- good pollinizer for higher yield “Mandarin”- effective pollinizer for lowering seed content	Thomas et al., (2000)
Wax Apple cv. “Long Red”	“Black” and “Thyoto” are better pollinizers. Increased fruit weight, fruit diameter, fruit length, better thickness, and better TSS	Tuan et al.,(2013)
Papaya	Variation in seed number, TSS, time of ripening, and maturity of the fruit	Sharma et al., (2008)

Table 3: Table showing average weight, length, diameter, seeds per fruit, seed weight, length: diameter of crossed-fruits under each treatment

Angular transformation was done in case of length:diameter [T1: Allahabad Safeda × Arka Kiran; T2: Allahabad Safeda × Baruipur Local; T3: Shweta × Arka Kiran; T4: Shweta × Baruipur Local; T5: Shweta (Self – pollinated); T6: Allahabad Safeda (Self – pollinated)]

Table 4: Characteristics of seeds under each treatment combination

Table 3: Analysis of Physical Parameters												
Treatment	**Fruit Weight**		**Length**		**Diameter**		**Seeds/Fruit**		**Seed weight**		**Length / Diameter ratio**[1]	
	Mean	**S.E.**	**Mean**	**S.E.**	**Mean**	**S.E.**	**Mean**	**S.E.**	**Mean**	**S.E.**	Mean	S.E.
T_1	62.21 (7.933)	0.177	45.96 (6.843)	0.122	47.67 (6.974)	0.053	198.70 (13.729)	1.116	1.39 (1.532)	0.066	5.629 (0.97)	0.114
T_2	65.29 (8.13)	0.144	46.87 (6.913)	0.093	50.04 (7.137)	0.104	155.90 (12.443)	0.479	1.10 (1.446)	0.032	5.554 (0.94)	0.027
T_3	148.42 (12.1)	0.577	56.10 (7.536)	0.185	66.29 (8.194)	0.129	293.23 (16.474)	1.595	4.11 (2.202)	0.171	5.27 (0.85)	0.117
T_4	131.48 (11.471)	0.316	54.81 (7.468)	0.068	60.55 (7.835)	0.132	288.95 (16.992)	0.36	2.79 (1.943)	0.043	5.471 (0.91)	0.069
T_5	148.35 (12.184)	0.318	57.81 (7.662)	0.106	65.93 (8.175)	0.105	230.89 (15.14)	0.546	3.90 (2.203)	0.068	5.371 (0.88)	0.035
T_6	83.03 (9.156)	0.147	52.75 (7.323)	0.117	51.63 (7.246)	0.115	205.36 (14.178)	0.758	1.20 (1.477)	0.047	5.799 (1.02)	0.005
C.D.	0.904		0.343		0.312		2.601		0.241		0.212	
SE(m)	0.318		0.121		0.11		0.915		0.085		0.075	
SE(d)	0.45		0.171		0.155		1.294		0.12		0.106	
C.V.	9.896		5.236		4.57		19.514		14.908		4.278	

Treatment combinations	Treatments	Mean no. of seeds/fruit	Mean seed weight/fruit (g)	Seed Character
'Allahabad Safeda' x 'ArkaKiran'	T1	198.7	1.39	Bold and kidney-shaped
'Allahabad Safeda' x 'Baruipur Local' Local	T2	155.9	1.1	Soft Seeded
'Shweta' x 'ArkaKiran'	T3	293.23	4.11	Bold Seeded
'Shweta' x 'Baruipur Local' Local	T4	288.95	2.79	Bold Seeded
'Shweta' ('Shweta')	T5	230.89	3.9	Bold Seeded
'Allahabad Safeda' (selfed)	T6	205.36	1.2	Soft Seeded

Table 5: Chemical parameters of crossed-fruits

Treatments	Total Soluble Solids/ TSS (°Brix)	Ascorbic Acid (mg/100 g)		
	Mean	S.E.	S.E.	Mean
T_1	9.3 (3.206)	0.045	0.077	184.07 (13.602)
T_2	9.27 (3.203)	0.038	0.09	91.811 (9.63)
T_3	9.19 (3.182)	0.086	0.249	126.6 (11.271)
T_4	9.35 (3.208)	0.083	0.144	133.9 (11.607)
T_5	10.84 (3.438)	0.048	0.125	203.017 (14.279)
T_6	7.77 (2.96)	0.027	0.188	162.21 (12.763)
C.D.	(0.167)			(0.446)
SE(m)	(0.059)			(0.157)
SE(d)	(0.083)			(0.222)
C.V.	(5.81)			(4.069)

Table 6: Morphological characters of fruits in the experiment:

Treatments	Fruit Colour	Fruit Shape	Relief of surface	Presence of ridges
T_1	Yellowish Green	Pome	Smooth	Present
T_2	Whitish green	Slightly oval	Smooth	Present (Less prominent)
T_3	Green	Pome	Rough	Present
T_4	Green	Pome	Rough	Present
T_5	Dark Green	Pome	Rough	Present
T_6	Light Green	Oval	Smooth	Absent